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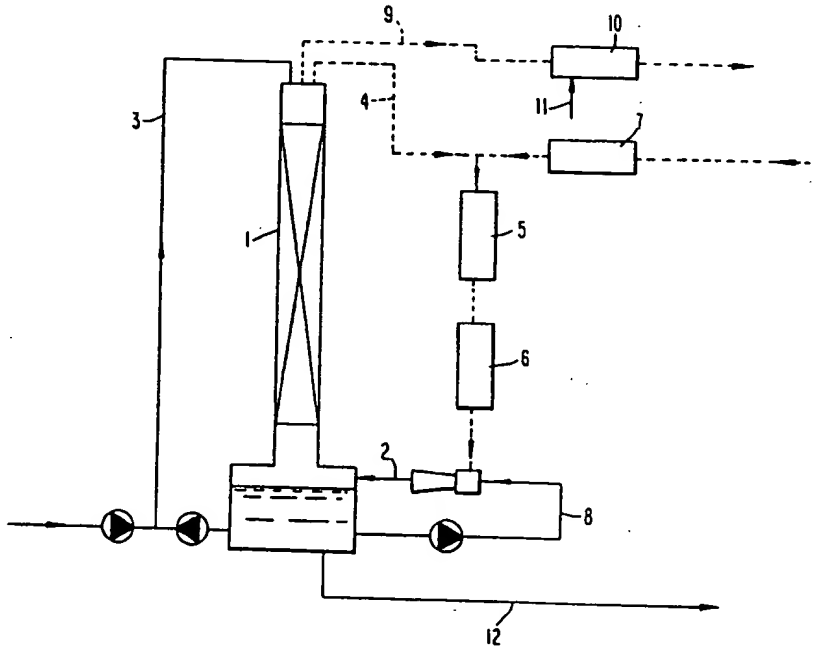
(54) Title: PROCESS AND APPARATUS FOR THE PURIFICATION OF CONTAMINATED WATER BY ACTIVATED OZONE



(57) Abstract

A process is provided for the purification of water which is contaminated with environmentally undesirable components, such as halogenated hydrocarbons, wherein the contaminated water or the gaseous and/or liquid components present therein or derived therefrom are subjected to at least two of the following treatments: treatment with ozone, treatment with UV radiation, treatment with a solid catalyst. A combined treatment with ozone and a solid catalyst, such as activated carbon, is preferred. An apparatus for a cocurrent or countercurrent realisation of the purification process is also provided. The apparatus can comprise one or more purification reactors.

Process and apparatus for the purification of contaminated water by activated ozone

This invention relates to a process for the purification of water contaminated e.g. with halogenated hydrocarbons, with activated ozone. The contaminated water may come available as groundwater from waste deposits, but also as direct effluents from household activities, urban conglomerates and industries.
From an environmental point of view, such effluents cannot be discharged without a thorough purification. Most current technologies like concentration/incineration, wet air oxidation, biotreating etc., have distinct disadvantages. They are either not economically viable, generate secondary waste problems or do not achieve sufficiently low residual concentrations for environmentally acceptable solutions.

The invention provides a solution for the above mentioned problems. It is applicable to a variety of toxic components in waste streams like halogenated hydrocarbons, including chlorine and bromine containing compounds, dioxines and PCB's, pesticides, insecticides, (polycyclic) aromatics, cyanides, (glycol) esters, organic acids, alcohols, hydrocarbons, etc., as well as micro-organisms.

The process according to the invention can be applied in the vapour phase (volatile components) as well as in the liquid phase. In both cases the active reagents are assumed to be oxidative radicals derived from activated ozone either by short wave UV radiation or by a solid catalyst.

If UV radiation is applied at a wavelength below 200 nm, and preferably at 185 nm, ozone can be produced from oxygen containing gas as well. At a wavelength in excess of 200 nm, and more specifically at 245 nm, UV radiation only activates ozone but does not produce additional ozone.

As the catalyst, a number of solid components can be used. Good results have been obtained using activated carbon (surface area 400-800

Table 1

GROUNDWATER PURIFICATION

VOLGERMEERPOLDER

contaminant	influent level (ppb)	effluent level (ppb)	local limits for discharge on surface water (ppb)
monochlorobenzene	7900	1.0	1.0
chlorophenols	500	0.3	1.0
EOCl	810	3.3	5.0
polycyclic aromatics	40	0.6	1.0
naphthalene	25	0.5	1.0
phenol	27	0.5	1.0
alkylphenols	320	0.2	1.0
benzene	1400	0.5	1.0

In the apparatus according to the invention, a variety of toxic components can be degraded. The apparatus consists of from 1 up to 10 reactors (100, 200, 300, ...) which can be columns packed with solid fillings or solid catalysts. The said reactors have a contaminated water supply (101, 201, 301, ...), a water discharge (102, 202, 302, ...) and a gas discharge (103, 203, 303, ...); further, the reactors (100, 200, 300, ...) are equipped with a recycle supply (104, 204, 304, ...) for ozone containing liquid and a recycle discharge (105, 205, 305, ...) for ozone depleted liquid, whereby a UV treating unit (106, 206, 306, ...) and/or an ozone supply (107, 207, 307, ...) can be included between the recycle supply (104, 204, 304) and the recycle discharge (105, 205, 305, ...).

The gas discharge (103) which is connected to a UV treating unit (108), and/or the gas discharge (109) of UV treating unit (108) is fed to a venturi (110) incorporated in a liquid recycle loop (111), which loop is connected to a reactor (100). In the liquid recycle loop (111), an electromagnetic water treatment installation (112) for eliminating metals such as iron or calcium, can be incorporated.

The ozone supply (107, 207, 307, ...) can advantageously be provided via an injection system such as a venturi (116, 216, 316, ...) connected

The invention is based on a catalytic oxidation process, which can be applied homogeneously (UV) or inhomogeneously (solid catalyst), or as a combination of homogeneous and inhomogeneous steps. The choice of the equipment is mainly determined by the reaction parameters and reaction kinetics of individual toxic components to be removed. Therefore, the apparatus described hereabove is only by way of an example, and various modifications of the apparatus can be contemplated within the scope of the present invention.

8. Apparatus according to claim 7, wherein a UV treating unit (106, 206, ...) and/or an ozone supply (107, 207, ...) is provided between the recycle supply (104, 204, ...) and the recycle discharge (105, 205, ...).

9. Apparatus according to claim 8, wherein the ozone supply (107, 207, ...) is connected to the water recycle loop (104, 204, ...) via an injection system such as a venturi (116, 216, ...).

10. Apparatus according to any of claims 7-9, wherein the gas discharge (103, ...) is connected, optionally via a UV treating unit (108) and/or a gas discharge (109), to a venturi (110) incorporated in a liquid recycle loop (111), which loop is connected to a reactor (100).

11. Apparatus according to any one of claims 7-10, wherein the discharge (103, 203, ...) is connected to an active filter (114) containing a solid catalyst having a surface area of at least 50 m^2/gram and a pore volume of over 0.1 cm^3/gram.

12. Apparatus for conducting the process according to any of claims 1-6, comprising a stripping tower (1) having a supply (2) for gas and/or gas containing liquid on the lower side, and on the upper side both a supply for the liquid to be treated (3) and a gas discharge (4) connected to a UV treating unit (5, 6) and to an ozone supply unit (7), whereby the discharge of the UV treating unit(s) (5, 6) is optionally connected to the supply (2) of the stripping tower (1), and the supply (2) can be part of a recycle loop (8).

13. Apparatus according to claim 12, wherein a solid catalyst is contained in the stripping tower (1) and/or in a unit (10) for treating the residual gas stream (9), which unit is connected to an ozone supply (11).

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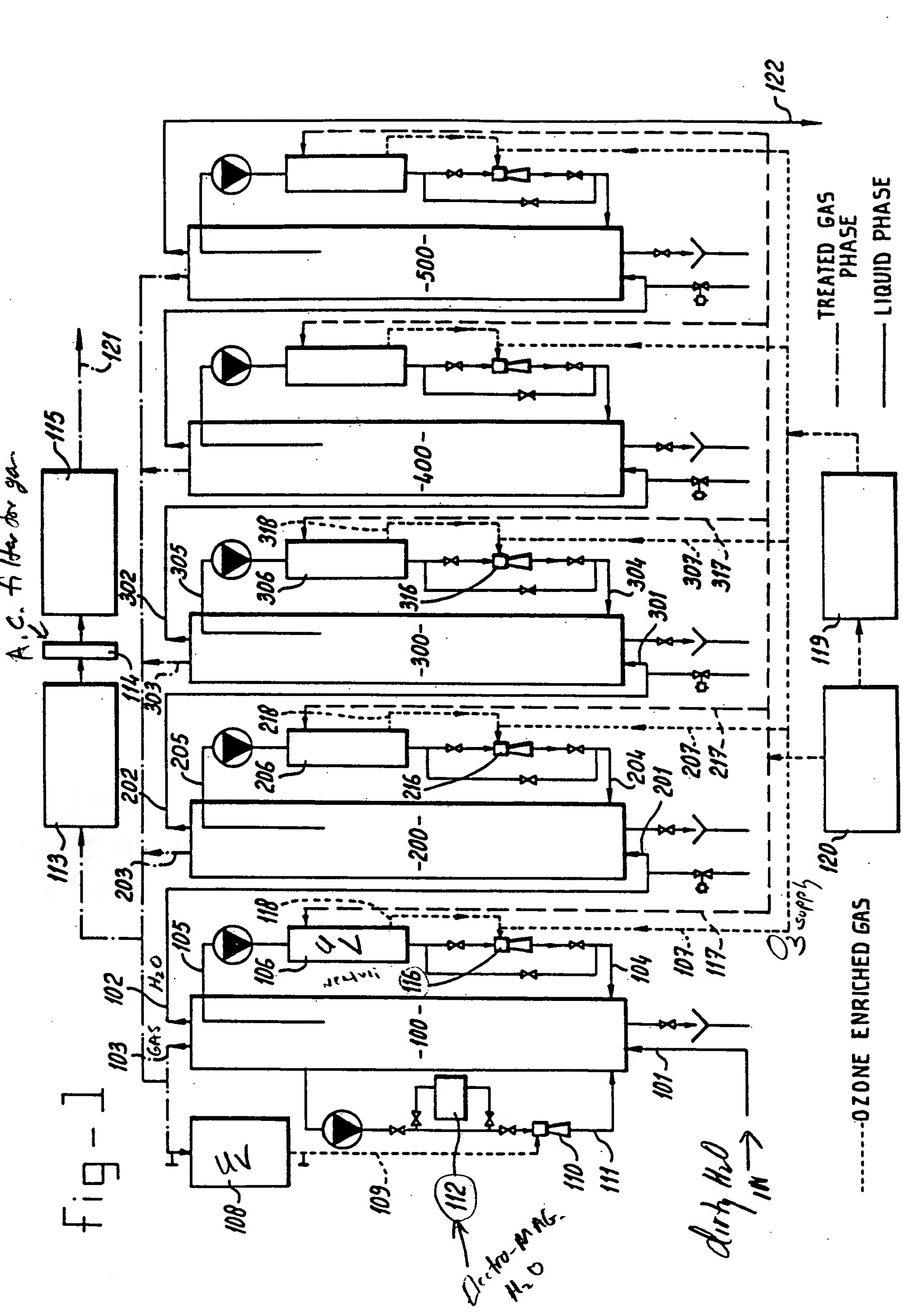

TREATED GAS PHASE
LIQUID PHASE
OZONE ENRICHED GAS
-100-
-200-
-300-
-400-
-500-
UV
A.C.
112

Fig-1

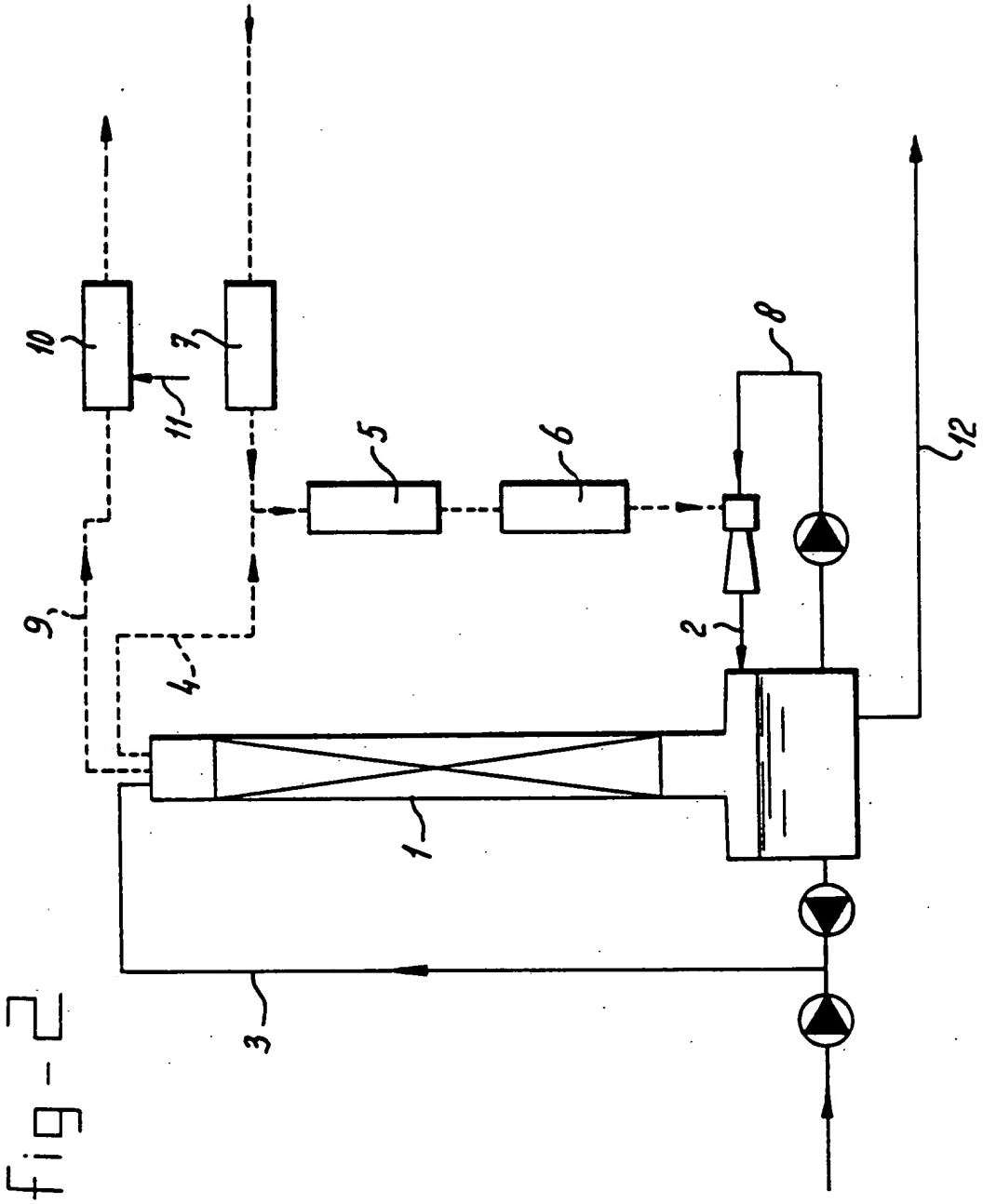

Fig - 2